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(54) **TISSUE CASSETTE WITH BIASING ELEMENT**

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See application file for complete search history.

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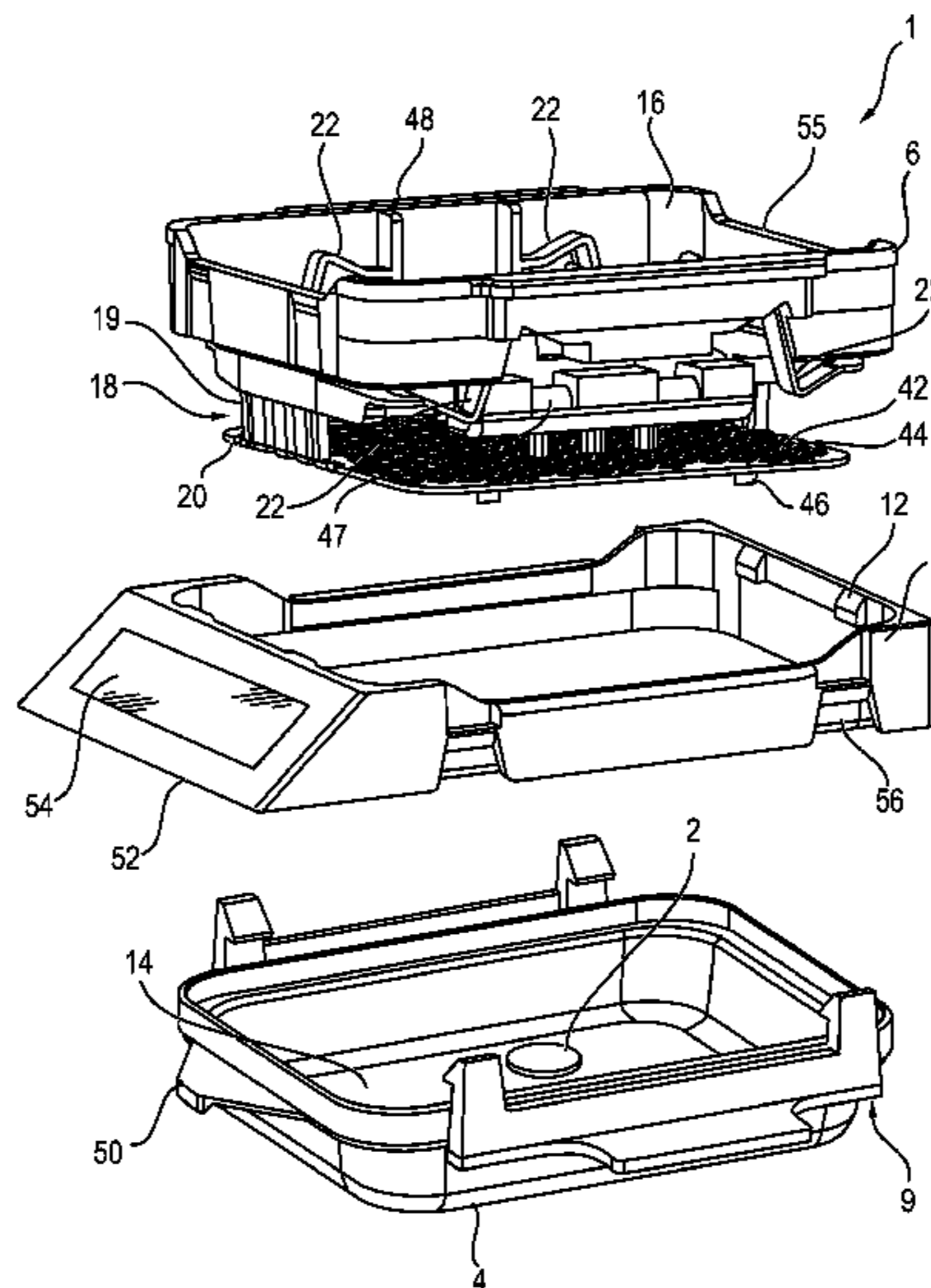
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(57) **ABSTRACT**

An apparatus for holding a tissue sample including a retaining member having a first tissue engaging surface and at least one biasing element, the first tissue engaging surface being moveably attached to the retaining member by said biasing element; and a base having a second tissue engaging surface and configured to engage the retaining member to form an interior area with the first and second tissue engaging surfaces facing each other, wherein the at least one biasing element urges the first tissue engaging surface toward the second tissue engaging surface to retain the tissue sample therebetween in the interior area.

**5 Claims, 11 Drawing Sheets**



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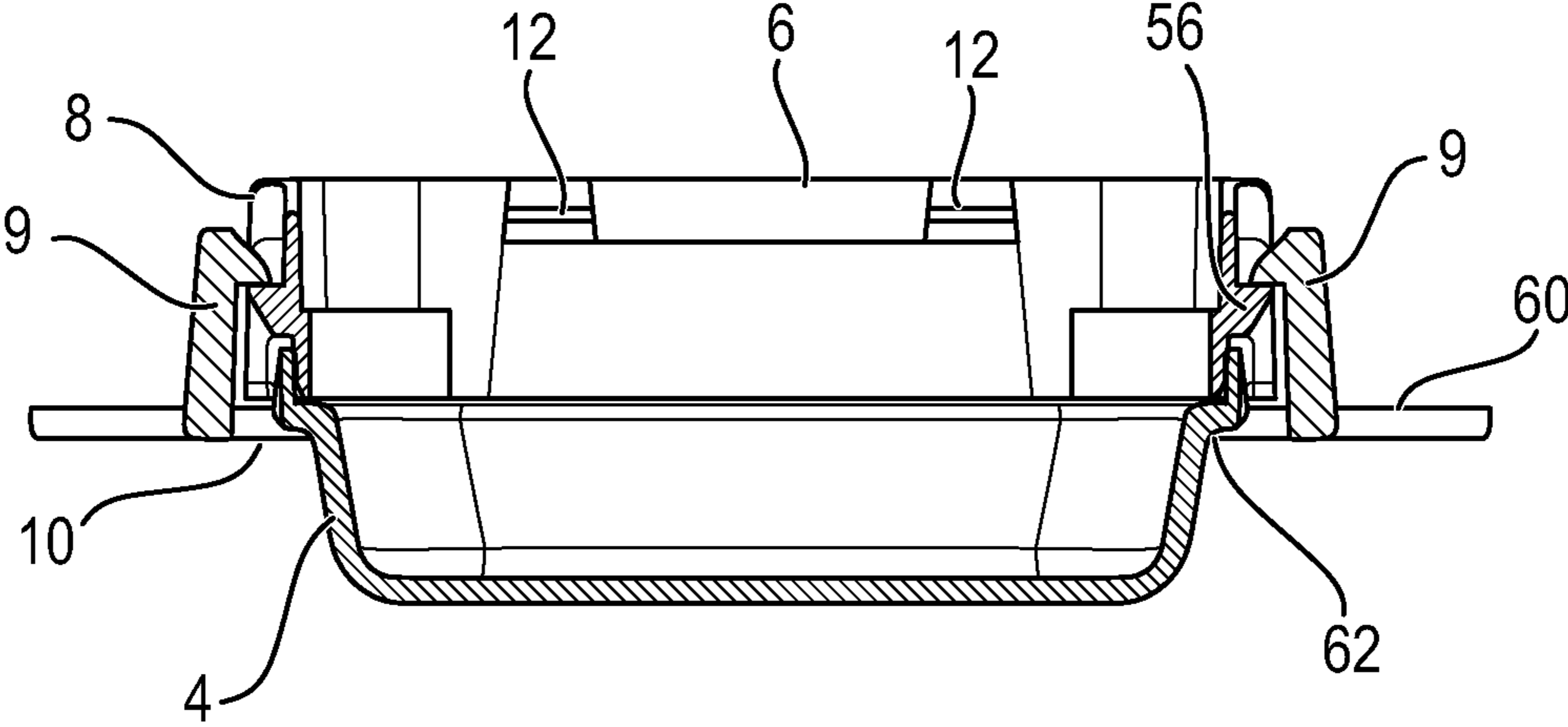


FIG. 2

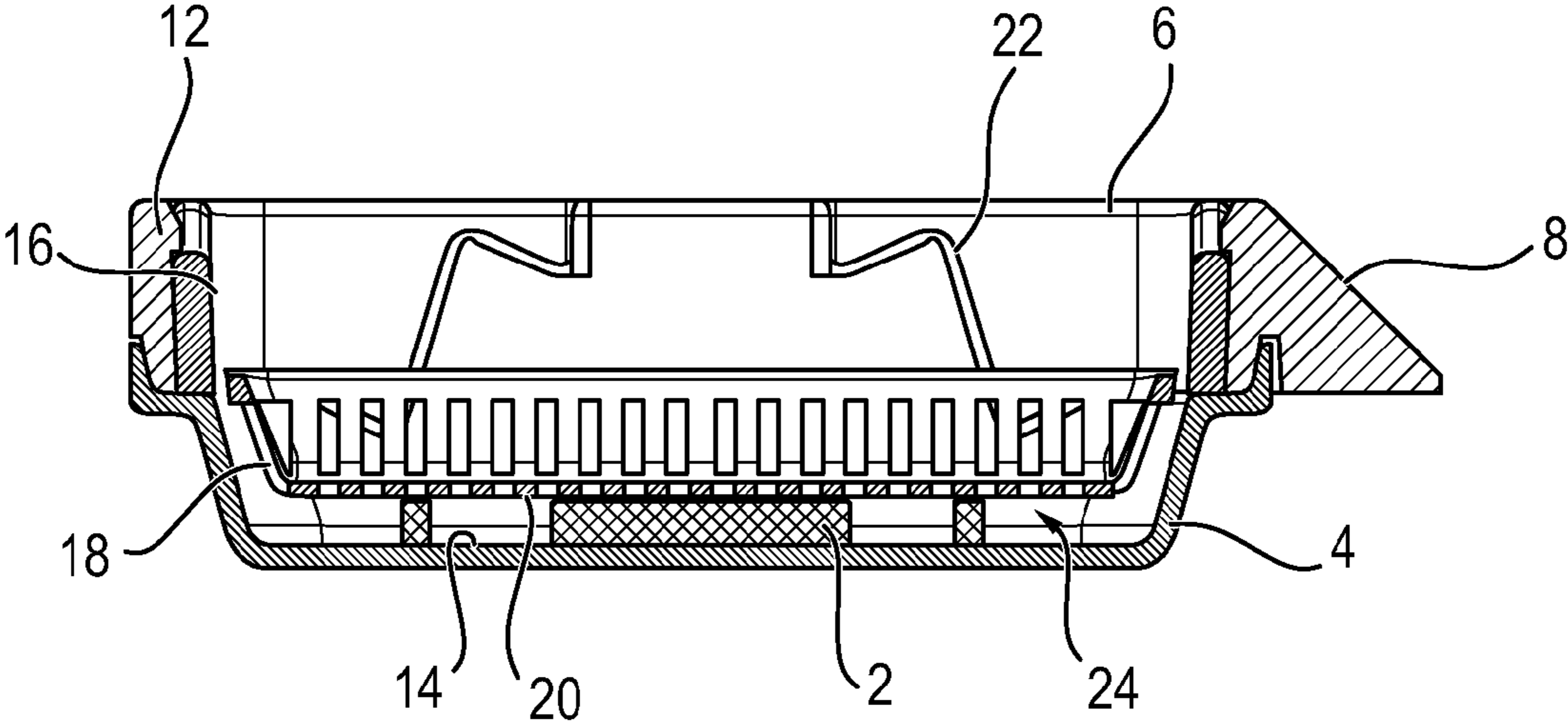


FIG. 3

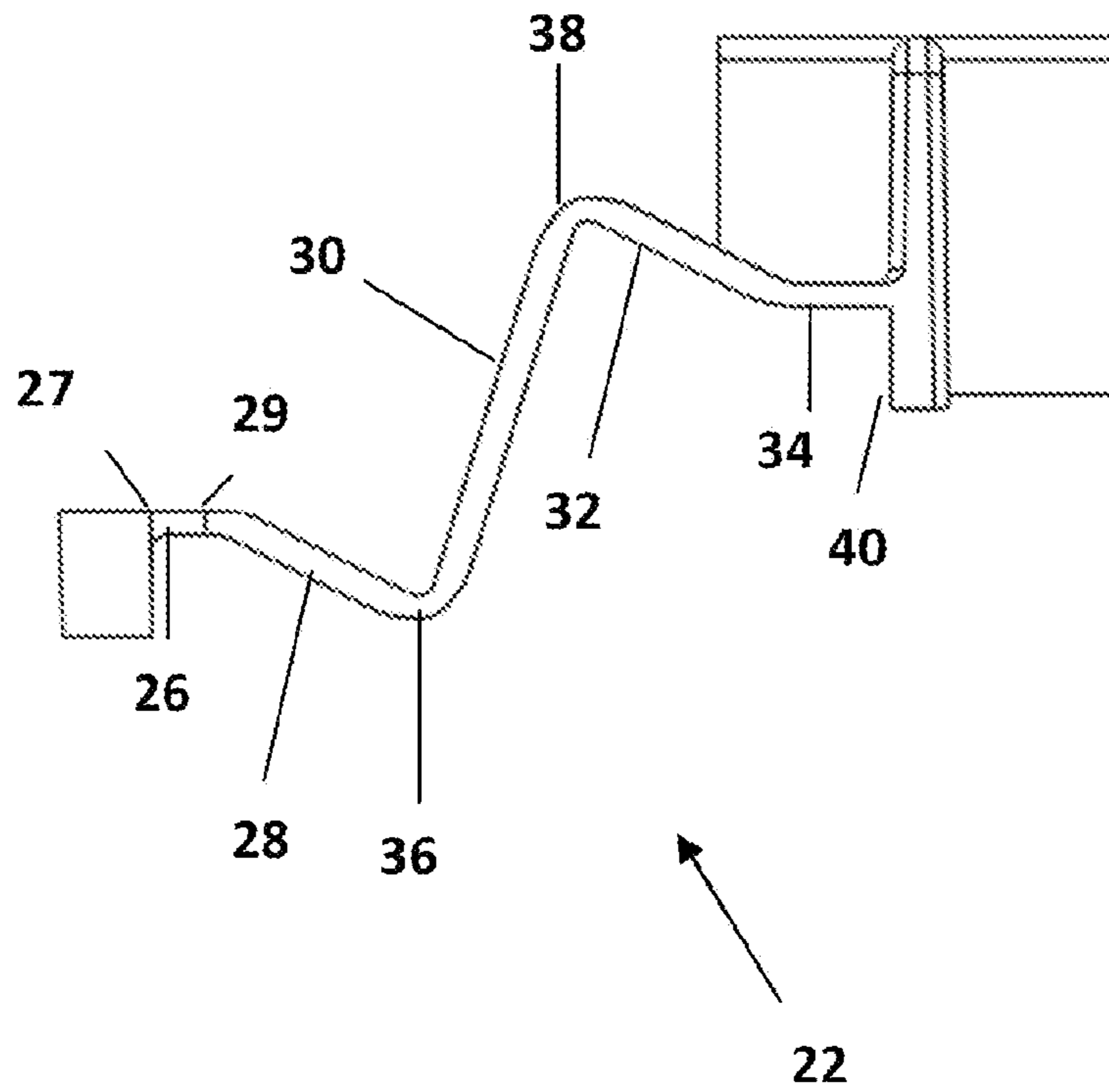


FIG. 4

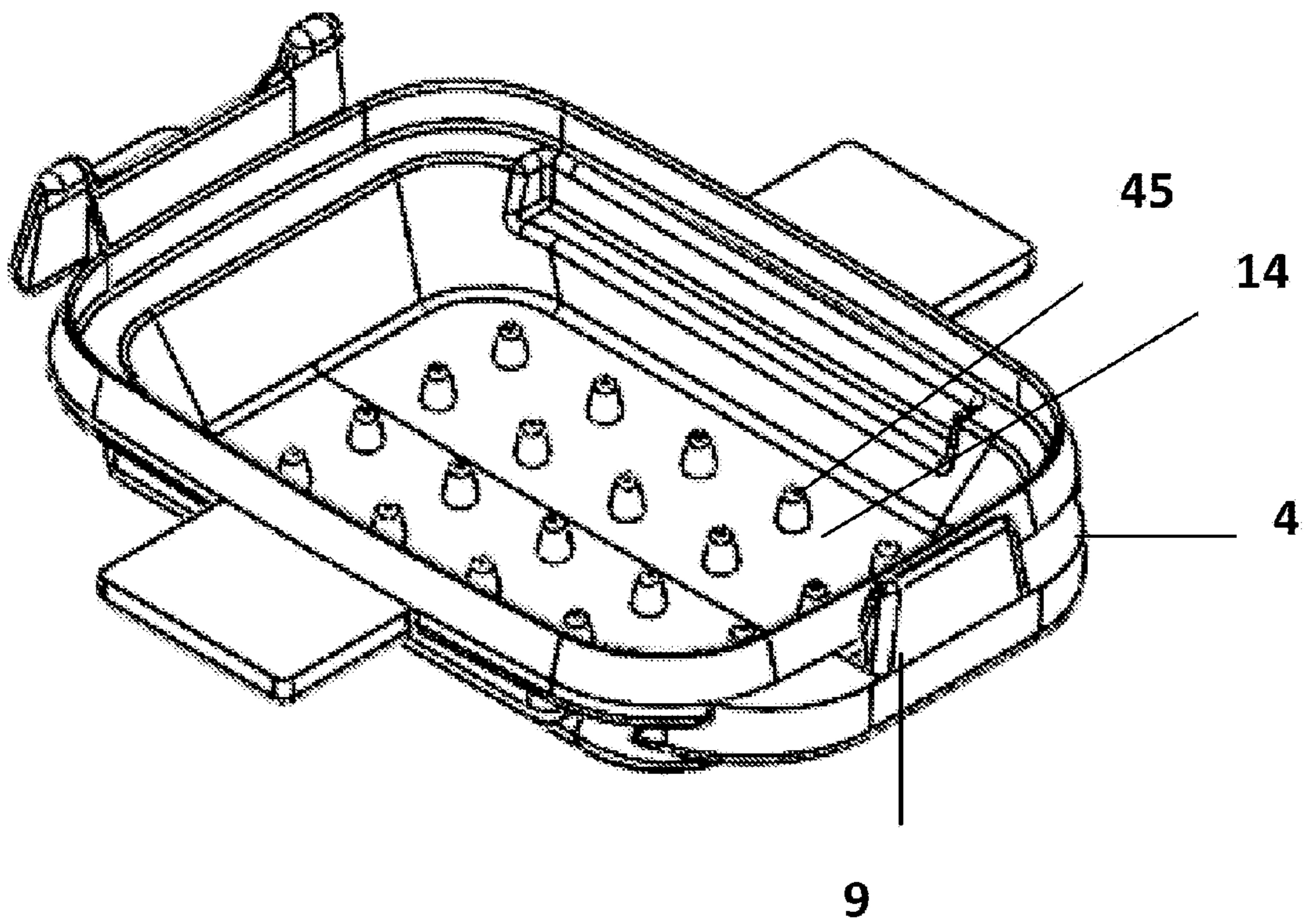


FIG. 5

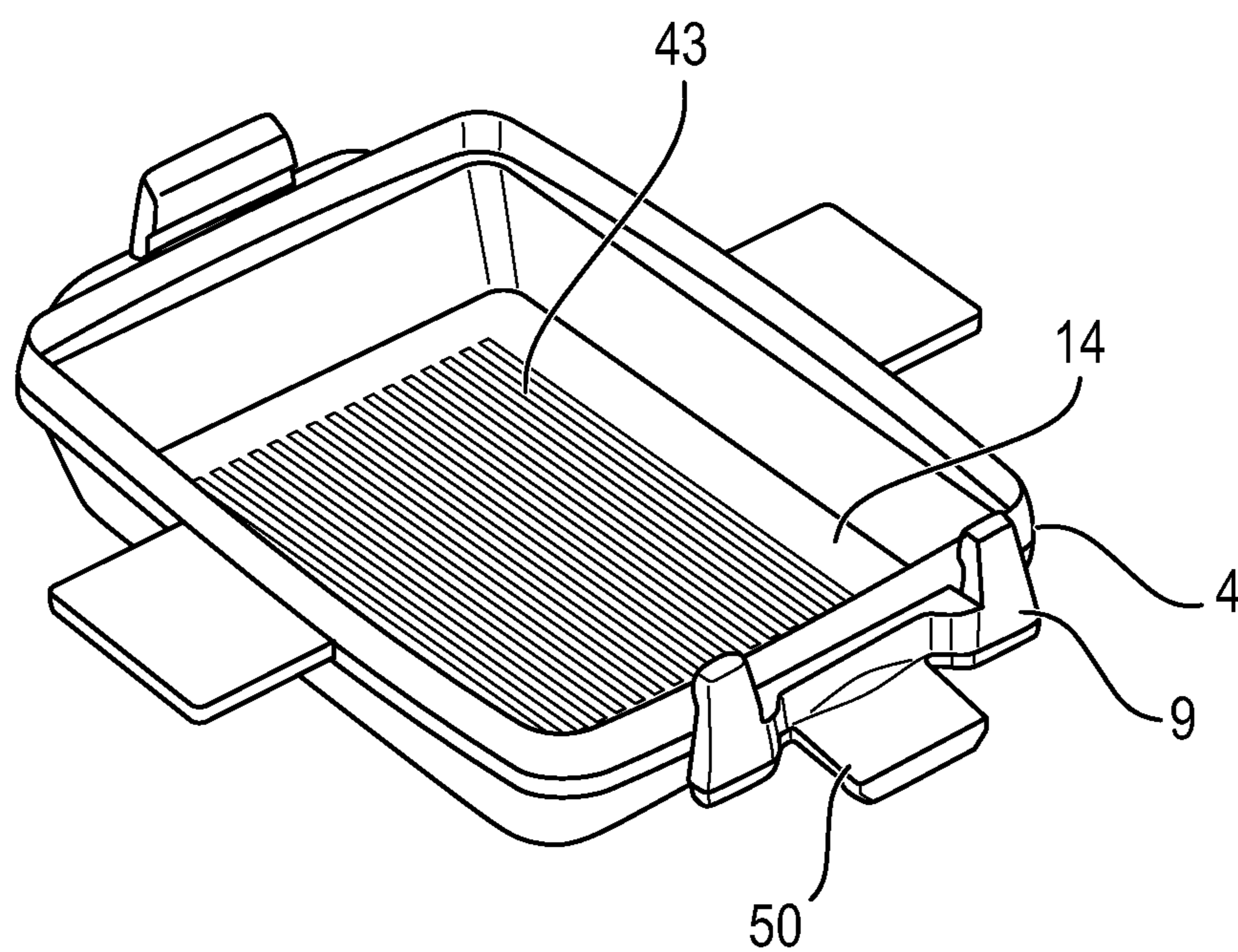


FIG. 6



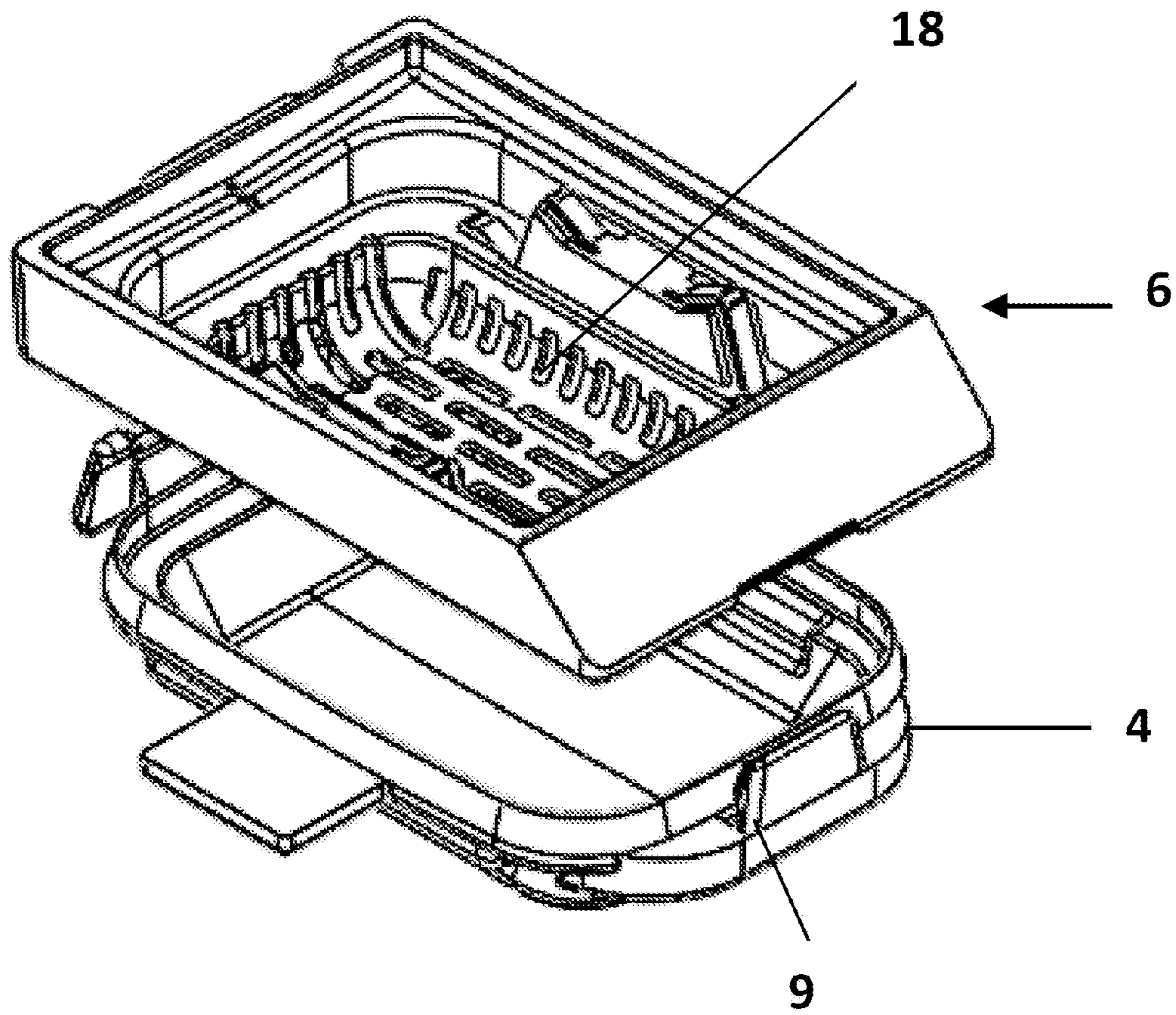


FIG. 7

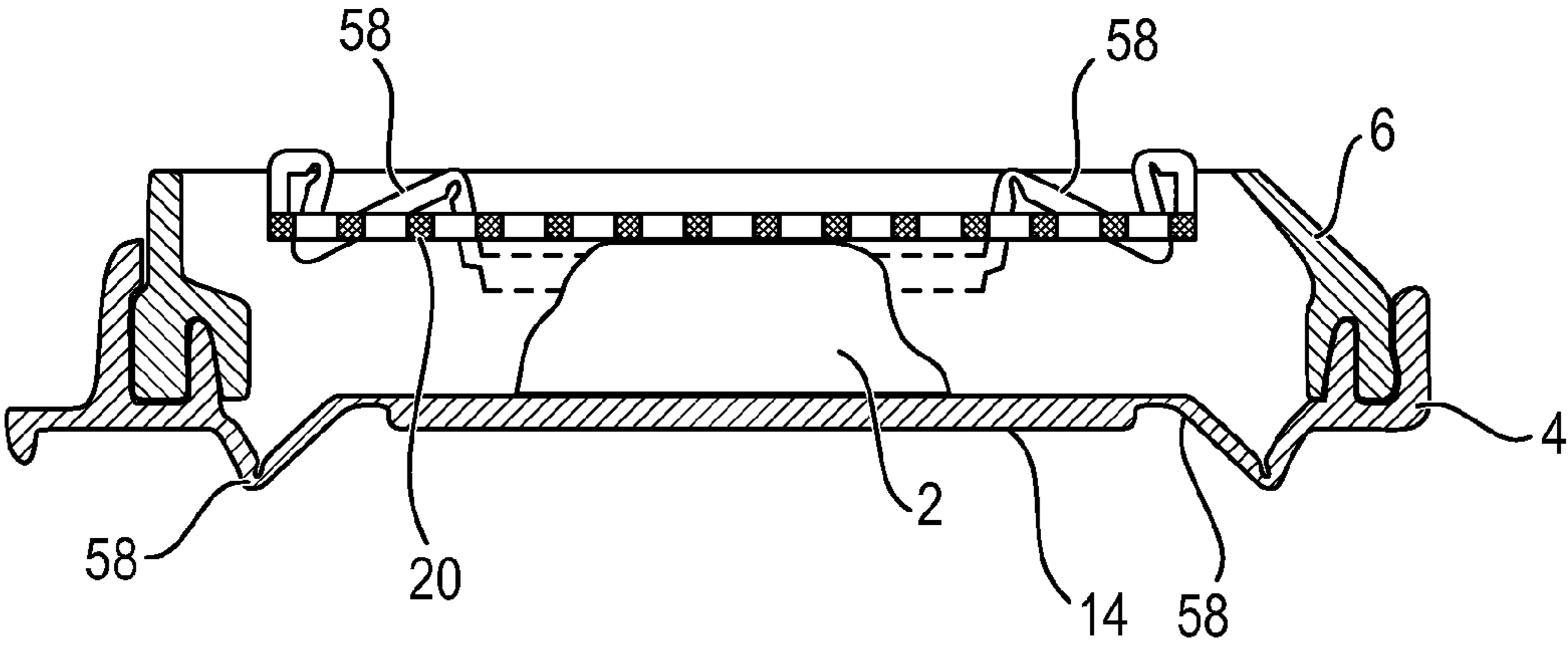


FIG. 8

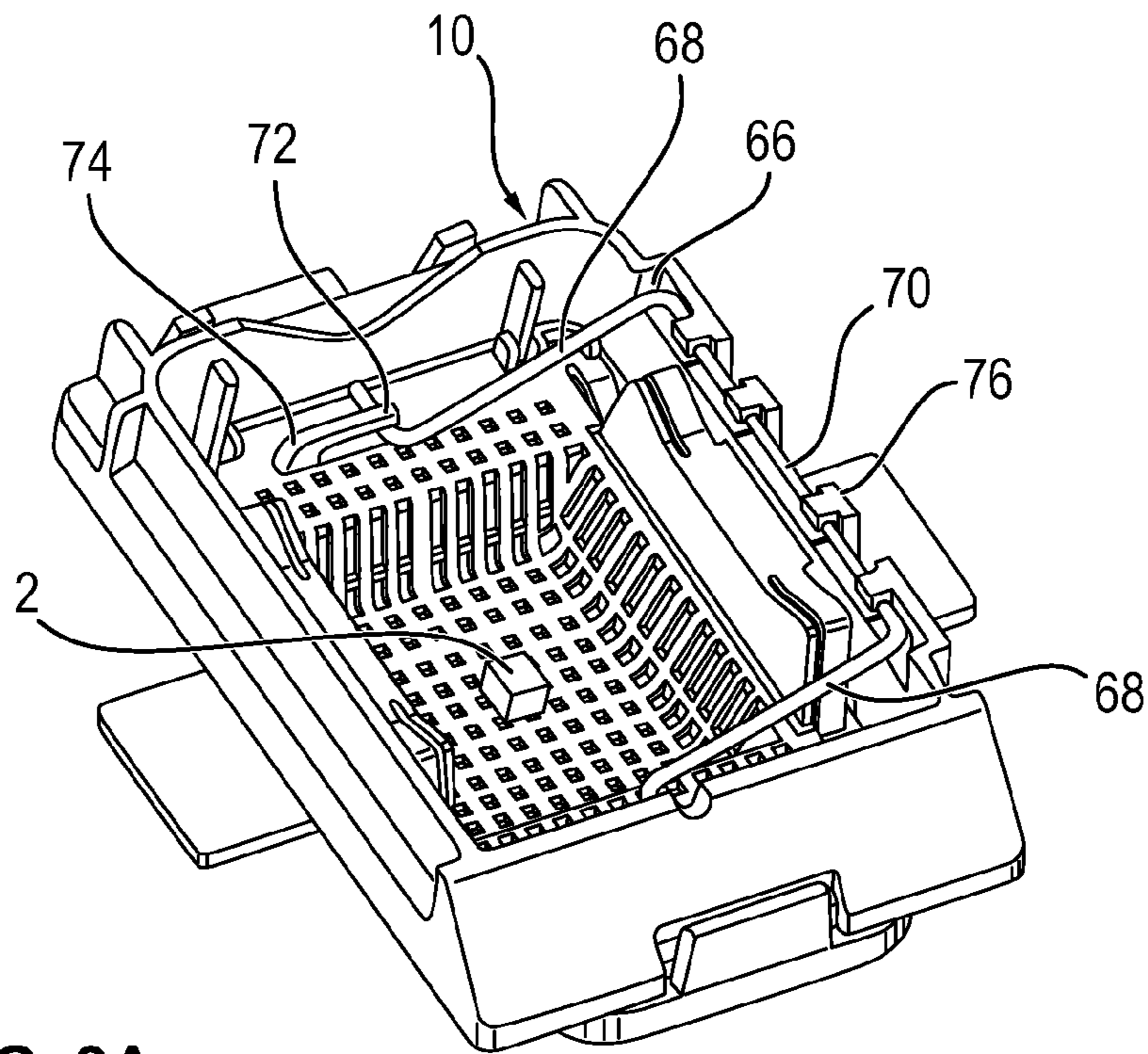


FIG. 9A

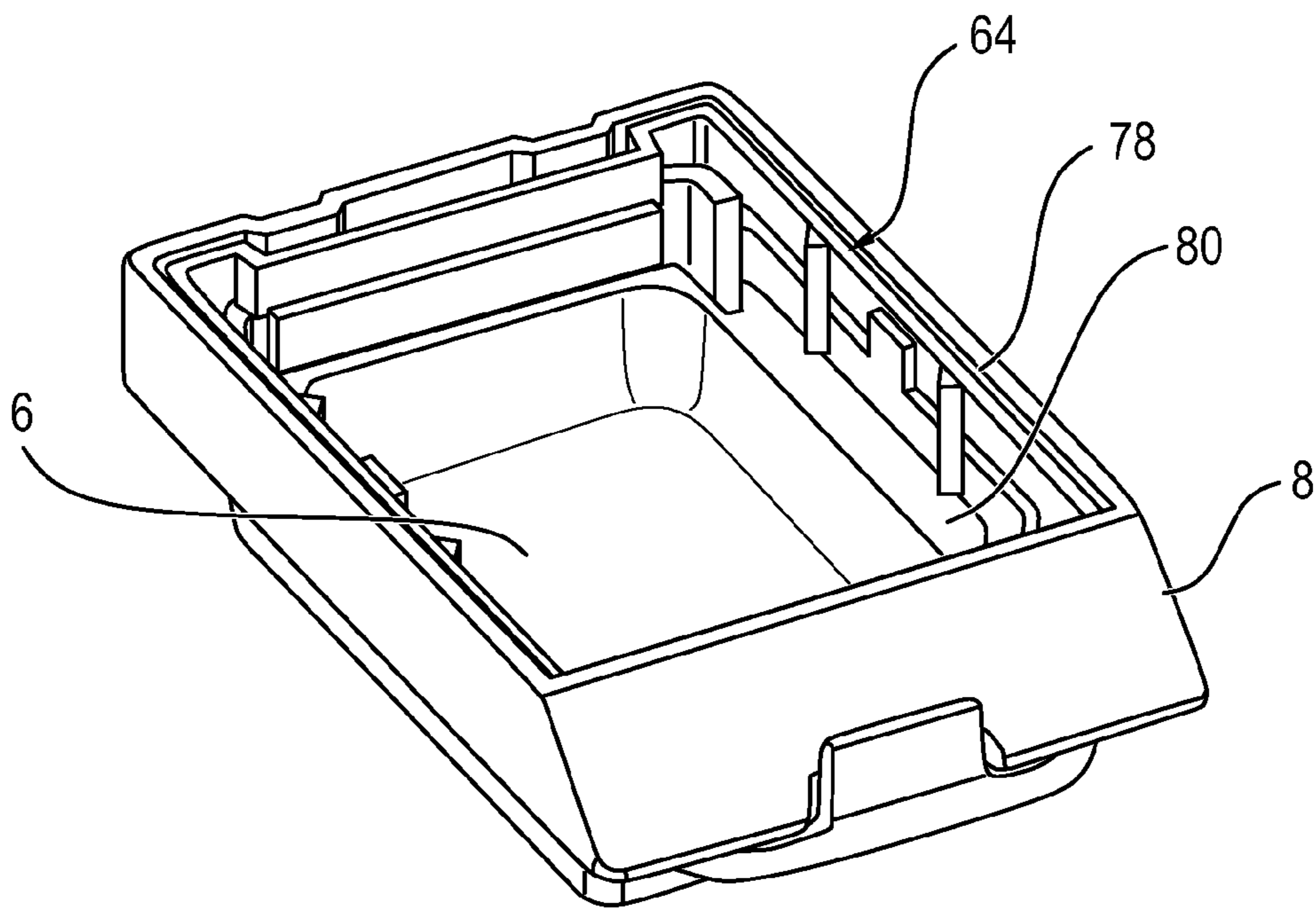


FIG. 9B

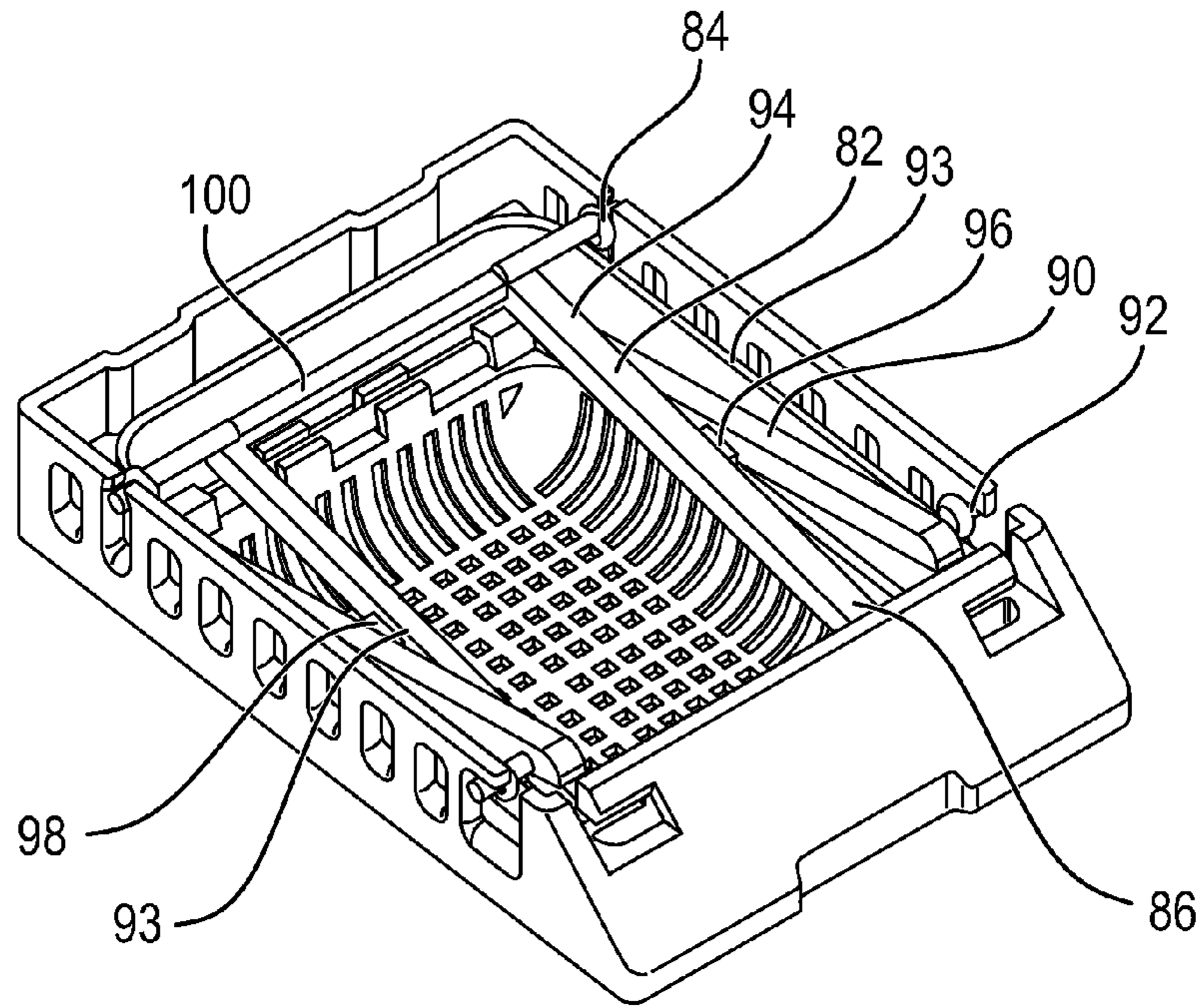


FIG. 10A

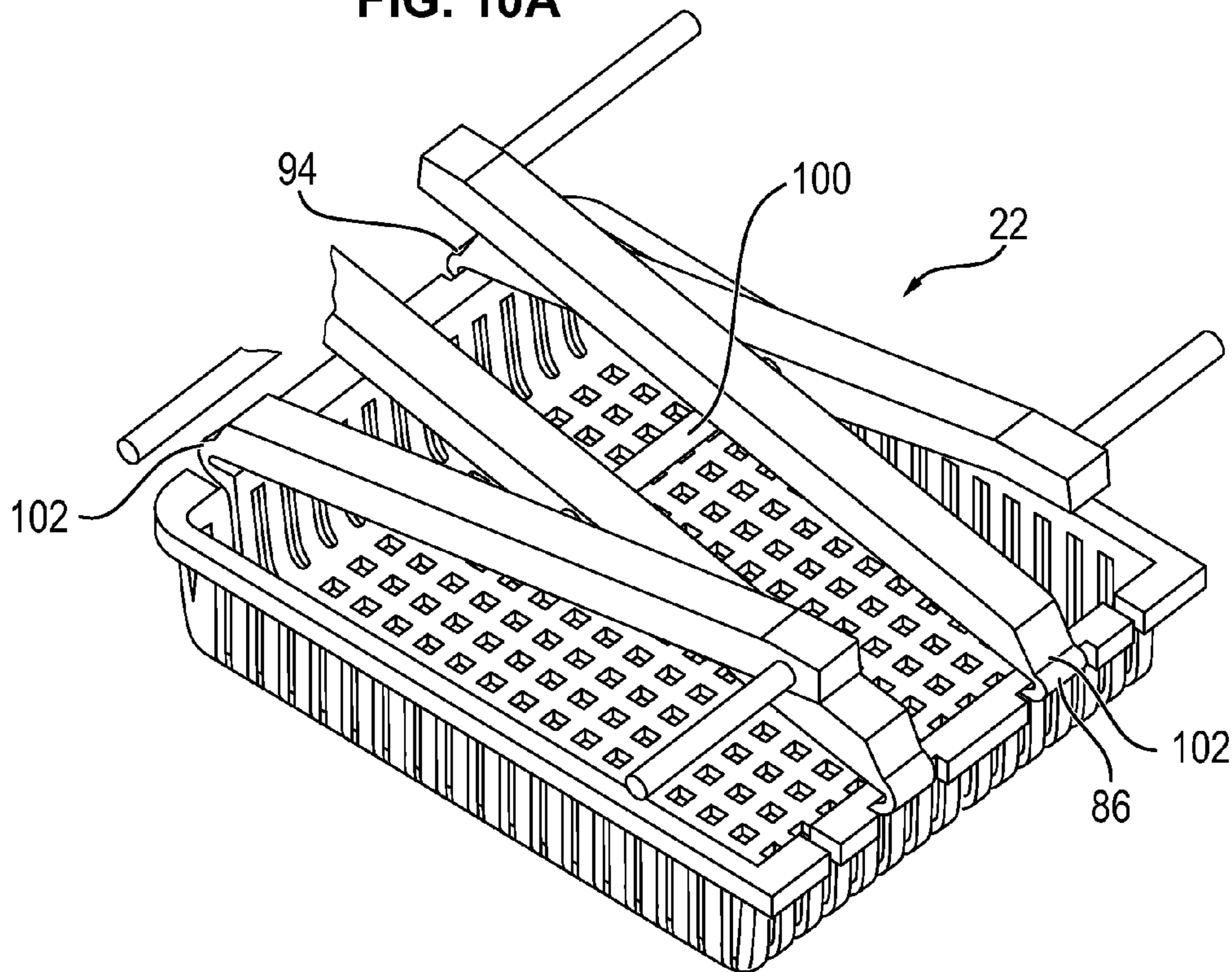


FIG. 10B

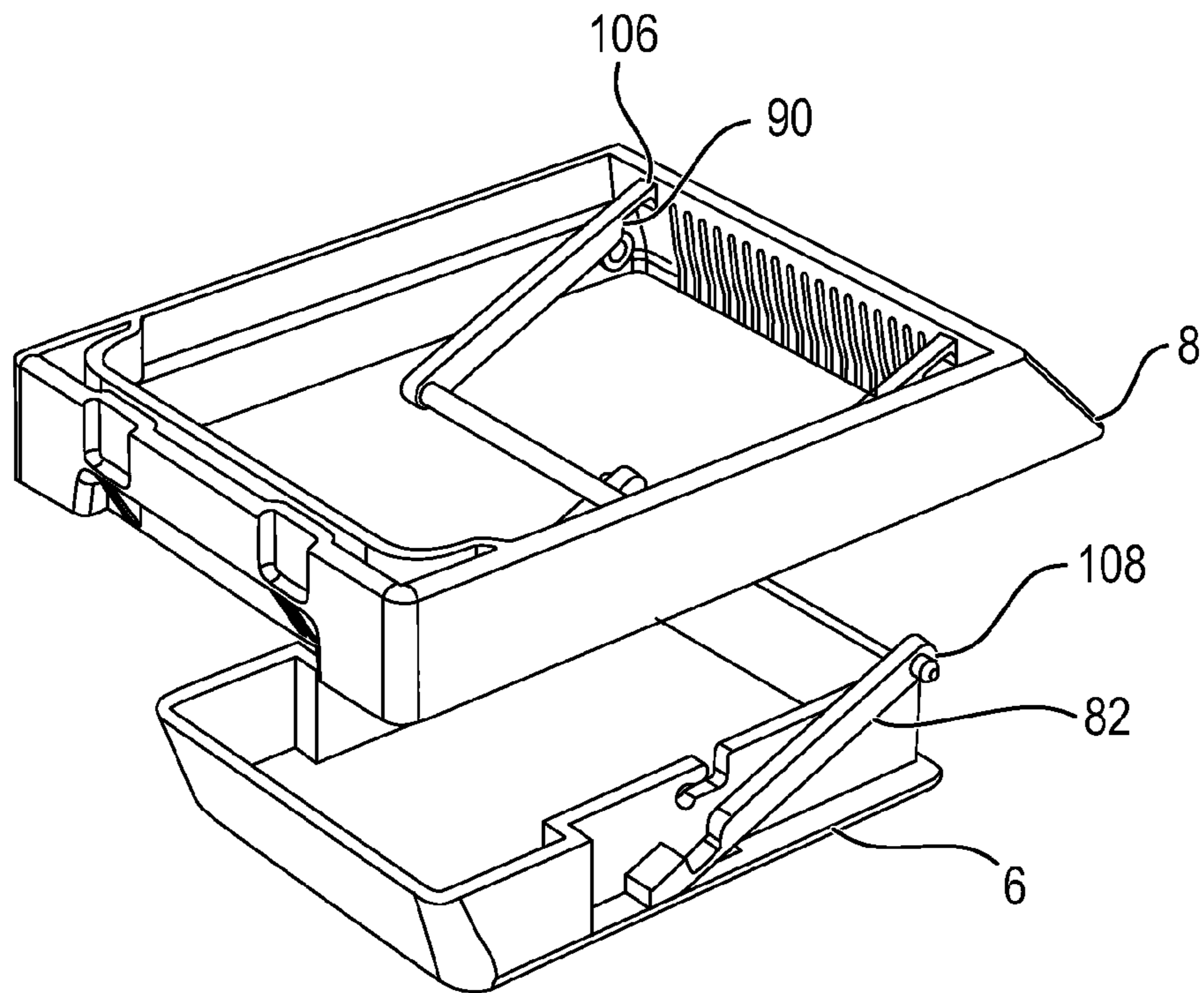


FIG. 11A

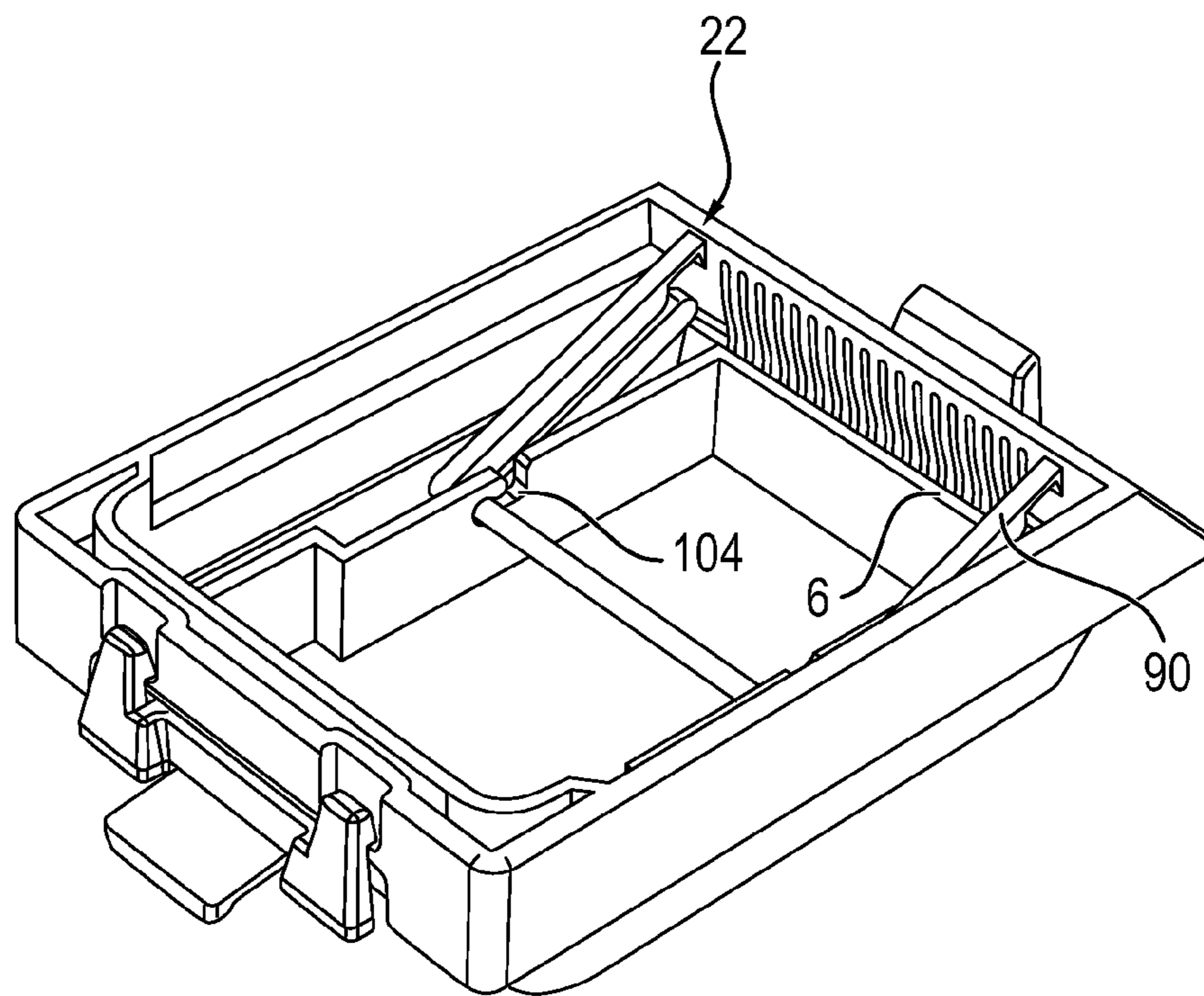


FIG. 11B

**1****TISSUE CASSETTE WITH BIASING  
ELEMENT**

## BACKGROUND OF THE INVENTION

The present disclosure relates generally to a tissue cassette for retaining a tissue sample.

## BACKGROUND

A biopsy is the removal of a tissue sample to examine tissue for signs of cancer or other disorders. Tissue samples are obtained in a variety of ways using various medical procedures involving a variety of the sample collection devices. For example, biopsies may be open (surgically removing tissue) or percutaneous (e.g. by fine needle aspiration, core needle biopsy or vacuum assisted biopsy).

After the tissue sample is collected, the tissue sample is analyzed at a lab (e.g. a pathology lab, biomedical lab, etc.) that is set up to perform the appropriate tests (such as histological analysis). Although this disclosure refers to a sample, it should be understood that the term sample can refer to one or more samples.

In order to properly process the tissue sample a series of steps may be performed including:

1. Grossing of the sample by cutting the sample to the proper size for analysis.
2. Fixing of the sample to immobilize molecular components and/or prevent degradation.
3. Embedding the sample in an embedding material, such as paraffin wax
4. Sectioning the embedded sample by using, for example, a microtome.

In conventional methods, the grossing step involves a lab technician cutting the tissue to the appropriate size for analysis and then placing the tissue in a tissue cassette. During the fixation stage, the cassettes are generally exposed to a fixing agent or chemical (e.g., a solution of formaldehyde in water such as formalin) shortly after sample collection. For example, U.S. Pat. No. 7,156,814 discloses a cassette which can withstand tissue preparation procedures.

After the tissue sample has been processed, the medical professional, in conventional methods, removes the tissue sample from the individual cassette to perform the embedding step. Specifically, the medical professional carefully orients the sample, based on the diagnostic view required, into a base mold containing an embedding material such as paraffin wax. Once the tissue is oriented properly in the base mold, the molten material is cooled to fully embed the tissue sample and hold it in the proper orientation. The paraffin is used to hold the sample in position while also providing a uniform consistency to further facilitate sectioning. While the term paraffin is used, this term is not limiting and describes an example of an embedding medium.

Then the sample is removed and sliced into a plurality of thin sections (e.g., 2 to 25 $\mu$  thick sections), often using a microtome, for further processing and inspection. Such sectioning of the sample often helps a medical professional properly assess the sample under a microscope (e.g. diagnose relationships between cells and other constituents of the sample, or perform other assessments).

The current process requires human intervention at both the grossing and embedding steps. Such manual handling of the sample can increase the likelihood of mis-identifying the sample, cross contaminating the samples, or losing part or the entire sample. Additionally, the numerous steps of manual

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manipulation can often increase the time that it takes to provide a proper assessment for each sample, once the sample is collected.

## SUMMARY OF THE INVENTION

This invention provides a device that allows for the tissue sample to be orientated during the grossing step and to remain in the same orientation through all steps to the embedding step. Through the multiple embodiments, the tissue sample cassette of this invention reduces the manual handling of the tissue samples. Example embodiments of this application may address one or more of the above identified issues. However, an embodiment of this application need not solve, address, or otherwise improve on existing technologies.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded view of a tissue cassette according to a first embodiment in a non-assembled state;

FIG. 2 shows an exterior sectional view the tissue cassette of FIG. 1 in an assembled state;

FIG. 3 shows an interior sectional view of the tissue cassette of FIG. 1 in an assembled state;

FIG. 4 shows a cut-out section of the biasing element on the tissue cassette of the above embodiment.

FIGS. 5-6 show an alternate embodiment of the base.

FIG. 7 is an exploded view of a tissue cassette according to another embodiment in a non-assembled state.

FIG. 8 is an interior side view of a tissue cassette according to another embodiment in an assembled state with the tissue sample.

FIGS. 9A-9B, 10A-10B and 11A-11B show the tissue cassette according to alternative embodiments.

## DETAILED DESCRIPTION OF THE INVENTION

In the following detailed description, reference will be made to the accompanying drawing(s), in which similar elements are designated with similar numerals. The aforementioned accompanying drawings show by way of illustration and not by way of limitation, specific example embodiments and implementations consistent with principles of an example embodiment. These implementations are described in sufficient detail to enable those skilled in the art to practice an example embodiment and it is to be understood that other implementations may be utilized and that structural changes and/or substitutions of various elements may be made without departing from the scope and spirit of an example embodiment. The following detailed description is, therefore, not to be construed in a limited sense.

FIGS. 1-3 illustrate a tissue cassette 1 according to a first exemplary embodiment of the present application. The tissue cassette 1 retains a tissue sample 2 in the proper orientation to allow for the automation of the processing and a reduction in human error.

A tissue cassette 1, according to one embodiment of the invention, has a base 4 and a retaining member 6 which cooperate to retain the tissue sample 2, as discussed below. In addition, a frame 8 may optionally be provided to surround the outer perimeter of the retaining member 6. In this embodiment, the base 4 is connected to the frame 8 by latching member 9, and the frame 8 is connected to the retaining member 6 by a locking member 12. In this way, the retaining member 6 fits into the inside perimeter of the base 4 as shown in FIGS. 2-3. The base 4 may have a sealing member 10 which forms a liquid seal between the frame 8 and the base 4.

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FIG. 3 shows the base 4 with a bottom surface which corresponds to a second tissue engaging surface 14. The retaining member 6 is formed with a rim portion 16 and a tissue retaining element 18 having a bottom surface corresponding to a first tissue engaging surface 20. Further, in a non-limiting embodiment, the retaining member 6 includes a biasing element 22.

In a non-limiting embodiment, the tissue retaining element 18 is attached to the rim portion 16 by the biasing element 22 and locking member 12. The biasing element 22 urges the tissue retaining element 18 away from the rim portion 16. The first tissue engaging surface 20 of the tissue retaining element 18 may be attached directly to the biasing element 22. Alternatively, the first tissue engaging surface 20 of the tissue retaining element 18 may be connected to the biasing element 22 by a connecting portion 19, which as shown in FIG. 1, may extend from the first tissue engaging surface 20 towards the rim portion 16.

Generally, when the base 4 and the retaining member 6 are engaged as shown in FIG. 3, an interior area 24 is defined between the base 4 and the retaining member 6 where the first tissue engaging surface 20 and the second tissue engaging surface 14 are facing each other. Prior to this engagement, a tissue sample 2 is placed into this interior area 24 in the desired orientation so that it rests on the second tissue engaging surface 14 of the base 4. Upon engagement of the base 4 with the assembly of retaining member 6 to frame 8, the biasing element 22 urges the first tissue engaging surface 20 of the tissue retaining element 18 towards the second tissue engaging surface 14 of the base 4 to firmly hold the tissue sample 2 in the chosen orientation between the first and second tissue engaging surfaces 14, 20 such that it can be held in position for processing and later be embedded with paraffin or the like.

The biasing element 22 will now be described in additional detail. As noted above the tissue retaining element 18 is attached to the retaining member 6 by at least one biasing element 22. In the illustrated embodiment in FIG. 1, the tissue cassette 1 has four biasing elements 22, where two biasing elements are shown in the Figure on one wall and the other two are on the opposite wall.

As shown in FIG. 1, each biasing element 22 is substantially hinged having an S or Z shape and attach at one end to the tissue retaining element 18 and attach at the other end to the inner surface of the rim portion 16. The biasing element 22 urges the tissue retaining element 18 towards the base 4 to fix the tissue sample 2 between the first and second tissue engaging surfaces 14, 20. Thus, the biasing element 22 can take on any shape that performs this function. For example, a torsion bar or a biasing element having another shape could also be used as discussed in more detail below.

In one non-limiting embodiment, as shown in FIG. 4, each biasing element 22 may have a first member 26 with a first end 27 and a second end 29. The first end 27 may be connected to the tissue retaining element 18. Extending downward at an angle from the hinge or second end 29 of the first member 26 is a first angled member 28. A second angled member 30 is connected to the first angled member 28 by a first curved hinged point 36. The second angled member 30 extends upwardly from the first angled member 28 at an angle; and in a non-limiting embodiment, the second angled member 30 and the first angled member 28 form an angle less than 90°. Extending downwardly from the second angled member 30 is a third angled member 32. The second angled member 30 and the third angled member 32 are connected by a second curved hinge point 38. In a non-limiting embodiment, the third angled member 32 and the second angled member 30 form an

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angle less than 90°. Further, in a non-limiting embodiment, the third angled member 32 and the first angled member 28 form an angle less than 90°. A second member 34 connects to the third angled member 32 at a hinge point and extends substantially parallel to the tissue retaining element 18. The second member 34 attaches to the rim portion 16 of the retaining member 6 in a non-limiting embodiment.

The biasing element 22 has a particular flexibility to ensure that the tissue sample 2 is held between the first and second tissue engaging surfaces 14, 20, on the one hand, but to also ensure that the tissue sample 2 withstands any permanent damage during processing. The preferred maximum biasing force depends on the tissue sample and is up to about 2.5N. Typically, biasing force may be measured using a force gauge.

More detail with respect to the retaining member 6 will now be provided with reference to FIGS. 1 and 2. In this exemplary embodiment, the retaining member 6 includes the rim 16, the biasing element 22, the connector 19, the retaining element 18 and the first tissue engaging surface 20. The rim 16 has four walls and a substantially rectangular shape. On the inside of the rim 16 one end of the biasing member 22 is attached. One end of the biasing member 22 attaches to the tissue retaining element 18 at either the connector 19 or the first tissue engaging surface 20. The tissue retaining element 18 of the retaining member 6 has a connector 19 and a first tissue engaging surface 20 with a substantially planar mesh portion 42. In this embodiment the mesh portion 42 is rectangular in shape, but the shape is not limiting and the mesh portion can be a variety of shapes. The mesh portion 42 of the first tissue engaging surface 20 has a plurality of perforations 44 or cut-outs. When the mesh portion 42 is urged against the tissue sample 2 it holds the tissue sample 2 in place and allows reagents, or the like, to flow to the tissue sample 2 through the perforations 44 in the mesh portion 42. The perforations 44 are sized to allow the flow of fluid to the tissue sample 2 on the one hand, but to prevent the escape of the tissue sample 2 on the other hand. Thus, the perforations 44 in the mesh portion 42 may be sized according to the size of the tissue sample 2. Further, the first tissue engaging surface 20, may alternatively be solid and have no holes on the surface while still allowing the agent to flow underneath the first tissue engaging surface 20 from the periphery.

The first tissue engaging surface 20 of the tissue retaining element 18, and/or the second tissue engaging surface 14 may contain topography to help orient the tissue sample. For example, the tissue engaging surfaces 14, 20 may contain prongs 45, ridges, hooks, or the like as shown on a second tissue engaging surface 14 in FIG. 5. In certain non-limiting embodiments, the tissue retaining element 18 has a semi-rigid structure to secure the tissue sample 2 without deformation; however, the tissue retaining element 18 may also have a rigid structure without changing the scope of the invention.

Further as shown in FIG. 1, the tissue retaining element 18 may also have protrusions 46 which extend downwardly from the tissue retaining element 18 towards the base 4. The protrusions 46 act as dead stops to prevent the tissue retaining element 18 from pushing down too hard against the tissue sample 2.

Additionally, in a non-limiting embodiment, the retaining member 6 may have handles 48 which function as grips for the lab technician when transporting the tissue cassette 1. Further, in a non-limiting embodiment, the retaining member 6 may contain a wire 47 which extends the length of the retaining member 6 and can be used for retraction when separating the retaining member 6 from the base 4.

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The base 4 will now be described with reference to FIG. 1. As discussed above, the tissue cassette 1 has a base 4 which supports the tissue sample 2 and holds the paraffin for embedding. The base 4, as shown in FIG. 1, has a generally rectangular shape with four side walls and a depressed bottom planar surface, referred to as the second tissue engaging surface 14. The base 4 has a rectangular shape depicted in the Figures; however, it is not limited to this shape and a different shape could be used without changing the scope of the invention. The base 4 is preferably solid so that it can hold the paraffin for embedding. The walls of the base 4 are preferably tapered inward to improve the ease at which the base can be removed from the paraffin after the embedding process.

As shown in FIG. 1, the base 4 has a solid, smooth bottom. However, in some embodiments the base 4 may have grooves or some other texture. As an example, the second tissue engaging surface 14 of the base 4 may have flow channels 43, depicted in FIG. 6, to assist in retaining the tissue sample 2 and improving fluid flow, without changing the scope of the invention. In an alternative embodiment, the base 4 may have a second depressed bottom for receiving the tissue sample such that the second depressed bottom creates an interior subsection with an area smaller than the interior area 24. The second depressed bottom 49 may be used for tissue samples 2 smaller in size.

In certain embodiments, the base 4 may also have drainage guides 50. The drainage guides 50 help to wick away the paraffin and to channel the paraffin away from the tissue cassette 1 after the tissue sample 2 has been embedded. The drainage guides 50 extend out from the outer peripheral of the base. In the embodiment shown in FIG. 6, the drainage guides 50 extend from one of the two end walls of the base; however the drainage guides 50 could extend from any wall on the base 4.

As noted above, in some embodiments a frame 8 is placed around the outside perimeter of the retaining member 6 and functions to secure the retaining member 6 to the base 4. The frame 8 may also be used as a means for identifying the tissue sample. As shown in FIG. 1, the frame 8 has a substantially rectangular shape with one end have an angled projection with an angled face 52. As shown in FIG. 1, a label 54 may be placed on the angled face 52 to identify the tissue sample 2. The labels 54 are described in more detail below. In this embodiment, the angle of the planar face is about 45 degrees, but the invention is not limited in this respect. The angled face 52 can be configured to receive a label such that the label 54 clicks into the angled face 52 of the frame 8. Alternatively, the frame 8 may have a textured surface and be put through an inkjet printing system, such as Leica IPC ink jet printer. In this instance, the tissue cassette 1 can be assembled after printing or the base 4 along with the frame 8 can be configured to be sent through the printer.

In a non-limiting embodiment, the frame 8 and the retaining member 6 are not easily removed so that once the tissue cassette 1 is used, the label 54 on the frame 8 will remain matched with the tissue sample 2 contained in the tissue cassette 1. In certain embodiments, frame 8 has a locking projections 12 which projects from the inside the perimeter of the frame 8, shown in FIG. 1. The locking projections 12 attach with an engaging portions 55 on the outer perimeter of the rim portion 16 on the retaining member 6 to secure the frame 8 to the retaining member 6. Once the frame 8 is connected to the base 4 using this locking arrangement, it is difficult to separate them.

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The base 4 includes a latching member 9 which acts as a clip or lock to hold the base 4 to the frame 8. Alternatively, if a frame 8 is not used, the latching member 9 can lock the base 4 to the retaining member 6.

As shown in FIG. 2, the latching member 9 is connected to a releasing member 60. The latching member 9 is flexibly attached to the base 4. When the latching member 9 is engaged, the latching member 9 attaches to the clip surfaces 56 on the outer perimeter of the frame 8. The latching member 9 locks the base 4 to the frame 8 which is attached to the retaining member 6. In this way, a sealing member 10 connects the latching member 9 to the base 4 to form a seal between the surfaces on the perimeter of the base 4 and the frame 8 to sufficiently prevent paraffin from leaking during embedding. In a non-limiting embodiment a gasket may be used as the sealing member 10 to help seal the base 4 and the frame 8. The latching member 9 is disengaged by pressing downward on the releasing member 60. When the releasing member 60 is pressed, the latching member 9 moves away from the base 4 and disengages from the clip surfaces 56. In the embodiment described above, the sealing member 10 extends from the base 4, but the sealing member 10 may also extend from the retaining member 6 or the frame 8.

An important aspect of tissue sample analysis is properly keeping track of tissue samples. In some embodiments, the tissue cassette 1 includes a label 54 or ID tag as shown in FIG. 1. The label can 54 be located anywhere on the tissue cassette 1, but is preferably located on the frame 8. In some embodiments, more than one tag may be present. When more than one tag is present, the tags can be physically separated or located together.

The label 54 may be a computer or human readable tag including, but not limited to, labels having an incorporated RFID, labels having an incorporated one-dimensional barcode (1-D barcode), labels having an incorporated two-dimensional barcode (2-D barcode), and labels having an incorporated three-dimensional barcode (3-D barcode). However, the computer readable label is not limited to RFID, 1-D barcode, 2-D barcode, or 3-D barcode labels and may include any type of label readable by a computer as would be apparent to a person of ordinary skill in the art.

In some embodiments, a label 54 is present that may be sensitive to changes to the sample or itself. For example, a label 54 may be present that changes physical (i.e. color) or chemical (i.e. redox, conjugation, etc.) properties during fixation of the sample. Similarly, a label 54 may be present that is sensitive to the processing steps which precede embedding (i.e. dehydration). Alternatively, a label 54 may be present that is sensitive to the embedding step (i.e. infiltration of paraffin). The label 54 may have a property that changes incrementally or switches when the step is complete. In this way, the technician, or an automated system, will be able to determine when the sample has finished one step before another is started.

The tissue cassette 1 can be made from various materials and the same or different materials can be used for the retaining member 6, including the tissue retaining element 18, the first tissue engaging surface 20, the mesh portion 42, and the base 4. Examples of materials used include: an acetal copolymer, Teflon, polypropylene, and stainless steel. In a non-limiting embodiment, the acetal copolymer is DELRIN 900. In a non-limiting embodiment, the base 4 is made out of a polypropylene material so that the base 4 does not attach to the paraffin after the tissue sample 2 is embedded. In a non-limiting embodiment, the sealing member 10 is made out of a polypropylene material.



In a non-limiting embodiment, the tissue cassette, including the base, the retaining member, and/or the frame, may be produced from a material lacking any dye or coloring. The lack of color may allow the technician to view the tissue sample in the tissue cassette and ensure that the tissue sample has remained in its desired orientation after embedding. In these embodiments, the tissue cassette, including the base, the retaining member, and/or the frame may be at least at least opaque or clear.

FIG. 7 shows a further embodiment of the tissue cassette 1. This embodiment is different from the previously described embodiments in the following respects. First, instead of having a separate frame, the frame of this embodiment is integrally incorporated into the retaining member 6. Second, the tissue retaining element 18 is shaped more like a basket, having four side walls. Lastly, the latching member 9 is formed on an end wall of the base 4, but has the same function of locking the base 4 to the retaining member 6. Other than these differences noted, the embodiment shown in FIG. 7 has the same configuration and tracks the same structure as discussed above.

FIG. 8 shows a further embodiment of the tissue cassette 1. This embodiment is different from the previously described embodiments in that in this embodiment, a biasing member 58 may be provided on either the base 4 or the retaining member 6 or both, along with the biasing element 22 as described in the above embodiments. In this embodiment, the biasing member 58 on the retaining member 6 may be pushing down and the biasing member 58 attached to the base 4 may provide a biasing force to move the second tissue engaging surface 14 away from the first tissue engaging surface 20. Further, the biasing member 58 attached to the retaining member 6 may permit the retaining member 6 to move away from the base 4 in response to the biasing force provided by the base 4. Similarly, the biasing member 58 attached to the base 4 may permit the base 4 to move away from the retaining member 6 in response to the biasing force provided by the retaining member 6. In this embodiment, the tissue sample container 1 is stable when either the biasing member 58 attached to the retaining member 6 or biasing member 58 attached to the base 4 is applying a biasing force, or when both are applying or not a biasing force.

For example, in this non-limiting embodiment, the biasing member 58 on the base 4 may be used only to enable the releasing of the force that is applied by the biasing member 58 on retaining member 6. As an example, in this embodiment, the tissue cassette 1 provides a two position floor. The first position is when the biasing member 58 on the base 4 compresses the second tissue engaging surface 14 upwardly such that the tissue engaging surface is compressed up towards the retaining member 6 to compress the tissue sample 2. The second position is when the force of the biasing member 58 on the base is released so that the second tissue engaging surface 14 is moves downwardly. In this way, the second tissue engaging surface 14 retracts away from the tissue 2, such that the floor of the base retracts, similar to the first tissue engaging surface 20 of the previous embodiments retracting towards and away from the tissue sample 2. Other than these differences noted, the embodiment shown in FIG. 8 has the same configuration and tracks the same structure as discussed above.

FIGS. 9-11 illustrate alternative embodiments of the invention which are directed towards maintaining parallel configuration of the first tissue engaging 20 surface when it urges towards the second tissue engaging 14 or when it retracts away from the second tissue engaging surface 14. FIGS. 9A and 9B illustrate examples of guiding members 64 which

assist the first tissue engaging surface 20 to maintain parallel configuration to the base 4 as it urges towards to the base 4. FIG. 9A illustrates a wire guide 66 used as the guiding member. In FIG. 9A the wire guide 66 is attached to the retaining member 10. The specific location is not limited; the wire guide 66 could be attached anywhere on the retaining member 10 including directly on the first tissue engaging surface 20. In the example shown in FIG. 9A, the wire guide 66 has a substantial U-shape with two parallel members 68 connected by a cross member 70. Projections 72 extend out from one end of each of the parallel members 68 to attach to clips 74 in the center of the retaining element 18. The wire guide 66 may pivot at the clips 74 such that when a downward force is applied to the wire guide 66 the retaining element 18 urges towards the tissue sample 2 along a central axis of the clips 74 to maintain a parallel configuration of the tissue retaining element 18 and the first tissue engaging surface 20 with the base 4. The cross member 70 can be locked into place by cross member clips 76 attached to the frame 8 or the retaining member 10.

FIG. 9B shows pillars 78 as guiding members 64. In this embodiment, pillars 78 extend vertically upward from the interior of the frame 8. Further, the side walls of the retaining member 6 have at least one cut-out 80 which are shaped to receive the pillars 78. Accordingly, the retaining element 18 can maintain a parallel configuration with the base 4 when it moves towards the tissue sample 2 or away from the tissue sample 2.

In addition to the guiding members 64 discussed above, there are alternative designs relating to the biasing element 22 which help to maintain the parallel configuration of the first tissue engaging surface 20 to the base 4. The biasing element 22 described above is one example of a means to hold the tissue sample 2 in the tissue cassette 1. As noted above, any design that performs the function of urging the first tissue engaging surface 20 against the second tissue engaging surface 14 can be used. Alternate embodiments of the biasing element 22 to remain parallel configuration of the first tissue engaging surface 20 with the base 4 are shown in FIGS. 10-11.

FIG. 10A and FIG. 10B illustrate an alternate embodiment to the biasing element 22. In these examples, the biasing element 22 includes two angled members. The first angled member 82 is fixed to the retaining member 6 at a fixed point 84 and angles downward from the fixed point 84 and attaches to the retaining element 18 at a first moving point 86. The second angled member 90 attaches to the retaining member 6 at a sliding point 92. The second angled member 90 is not fixed at the sliding point 92 and can slide against an inner ledge 93 of the retaining member 6 in a direction parallel to the second tissue engaging surface 14. The second angled member 90 extends downward from the sliding point 92 and attaches to the retaining element 18 at a second moving point 94. The first angled member 82 and the second angled member 90 are angled such that the members cross substantially in the center of each member at a hinge point 96.

In this embodiment, the first angled member 82 is fixed to the retaining member 6 at the fixed point 84. The second angled member 90 is attached to the retaining member 6 at the sliding point 92. Thus, the second angled member 90 can slide only in the direction parallel to the second tissue engaging surface 14. Accordingly, as the first angled member 82 and the second angled member 90 urge the first tissue engaging surface 20 towards the tissue sample 2, the first moving point 86 and the second moving point 94 move towards the tissue sample 2 while keeping the first tissue engaging surface 20 parallel to the base 4, for example.

In certain embodiments as shown in FIG. 10A, the pair of angled members **82**, **90** cross at the hinge point **96** and are connected by a torsion bar **98**. As shown in FIG. 10A, the pair of angled members may be provided on each side of the tissue cassette **1**. Accordingly, the tissue cassette **1** has two pairs of angled members, although the number of pairs of angled members is not limiting. The two pairs of angled members are attached by a connecting bar **100**. The connecting bar **100** can connect the two pairs of angled members at any point along the members.

FIG. 10B shows an alternate embodiment, where the biasing element **22** is provided by a flexible hinges **102** at the connection points between the first and second angled member and the retaining element **18**. That is, there are flexible hinges **102** at the first moving point **86** or the second moving point **94**. Similar to the embodiment described in 10A, the first tissue engaging surface **20** can maintain a parallel configuration to the base **4** while moving towards the tissue sample **2**. The flexible hinges **102** allow pair of angled members to flex under pressure.

Alternatively, as shown in FIGS. 11A and 11B, the biasing element **22** can comprise two angled members extending in a parallel direction. The first angled member **82** is attached to the retaining member **6** and the second angled member **90** is attached to the frame **8**. In FIG. 11A, the frame **8** and the second angled member **90** are placed over the retaining member **6** and the first angled member **82** so that the first angled member **84** and the second angled member **90** are adjacent to each other and extend in parallel directions.

The second angled member **90** contacts to the retaining member **6** at a hinge **104** and attaches to the frame a first pivot point **106**. The first angled member **82** attaches to the frame **8** at a second pivot point **108**. Accordingly, the retaining element **18** may be moved towards the tissue sample **2** in a parallel manner by the first angled member **82** pivoting about the second pivot point **108** and the second angled member **90** rotating about the first pivot point **106**. When the two angled member rotate about their respective pivot points the retaining element **18** moves in a substantially a parallel direction. Similar to the embodiment describe with respect to FIGS. 11A and 11B, a torsion bar may be provided in this embodiment. The torsion bar may be located at any point where the two pair of angled members connect.

An example of the use of the tissue cassette **1** in the analysis process will now be described. The tissue sample **2** is extracted and sent to a lab for analysis. In certain non-limiting embodiments, a gel may be placed on a tissue engaging surface, for example the second tissue engaging surface **14** as an adhesive to further secure the tissue sample **2**. An example of gel for use include agarose, agarose derivatives, modified agarose, low melt agarose, hydroxyethylagarose, low molecular weight agarose, agar, alginates, dextran, mannan, pectin, Ghatti gum and cellulose including hydroxypropyl-cellulose, histogel, hydrogel or combinations thereof. Then the tissue sample **2** is orientated and placed onto the second tissue engaging surface **14** of the base **4** of the tissue cassette **1**. The retaining member **6** is then placed over the base **4** and secured in place by the frame member **8**. Once the cassette is assembled, the biasing element **22** in the retaining member **6** is deflected to urge the tissue retaining element **18** of the retaining member **6** towards the tissue sample **2** such that the tissue sample **2** is held in its oriented position.

The tissue cassette **1** is then processed and exposed to a molten substrate. In a non-limiting embodiment, the tissue cassette **1** is filled with paraffin. The molten paraffin infiltrates the tissue cassette **1** and enters the interior area **24** to embed the tissue sample **2** in its oriented position. The paraffin is then

cooled such that it hardens at which point the tissue sample is embedded in a paraffin block and ready for sectioning. The base **2** is disengaged from the frame **8** such that the paraffin block including the tissue sample is exposed, resting on the first tissue engaging surface **20** of the retaining member. The paraffin block including the tissue sample can then be sectioned using a microtone. After the tissue sample **2** is sliced it is ready to be placed on a microscope slide for further processing and inspection.

Although a few example embodiments have been shown and described, these example embodiments are provided to convey the subject matter described herein to people who are familiar with this field. It should be understood that the subject matter described herein may be embodied in various forms without being limited to the described example embodiments. The subject matter described herein can be practiced without those specifically defined or described matters or with other or different elements or matters not described. It will be appreciated by those familiar with this field that changes may be made in these example embodiments without departing from the subject matter described herein as defined in the appended claims and their equivalents. Further, any description of structural arrangement of components or relationship there between is merely for explanation purposes and should be used to limit an example embodiment.

Aspects related to the example embodiment have been set forth in part in the description above, and in part should be apparent from the description, or may be learned by practice of embodiments of the application. Aspects of the example embodiment may be realized and attained using the elements and combinations of various elements and aspects particularly pointed out in the foregoing detailed description and the appended claims. It is to be understood that both the foregoing descriptions are an example and are explanatory only and are not intended to be limiting.

What is claimed is:

1. An apparatus for holding a tissue sample comprising,
  - a retaining member having a first tissue engaging surface and at least one biasing element, the first tissue engaging surface being moveably attached to the retaining member by said biasing element; and
  - a base comprising a second tissue engaging surface and configured to engage the retaining member to form an interior area with the first and second tissue engaging surfaces facing each other,
    - wherein the at least one biasing element urges the first tissue engaging surface toward the second tissue engaging surface to retain the tissue sample therebetween in the interior area,
    - wherein the biasing element is substantially hinged,
    - wherein the biasing element comprises:
      - a first member connected at a first end to the first tissue engaging surface and that extends substantially parallel to the first tissue engaging surface;
      - a first angled member which extends downward from a second end of the first member;
      - a second angled member connected to the first angle member extending upward, wherein the second angled member and the first angled member form an angle less than 90°;
      - a third angle member connected to the second angled member extending downward, wherein the third angled member and the second angled member form an angle less than 90°; and

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- a second member connected to the third angle member and that extends substantially parallel to the first tissue engaging surface.
2. An apparatus for holding a tissue sample comprising, a retaining member having a first tissue engaging surface and at least one biasing element, the first tissue engaging surface being moveably attached to the retaining member by said biasing element; and
- a base comprising a second tissue engaging surface and configured to engage the retaining member to form an interior area with the first and second tissue engaging surfaces facing each other,
- wherein the at least one biasing element urges the first tissue engaging surface toward the second tissue engaging surface to retain the tissue sample therebetween in the interior area,
- wherein the retaining member comprises two biasing elements for moveably supporting the first tissue engaging surface such that the first tissue engaging surface is urged toward the second tissue engaging surface,
- wherein the retaining member comprises a rim portion and a tissue retaining element on which the first tissue engaging surface is defined, and
- wherein the tissue retaining element is connected to the rim portion by the biasing elements.
3. The apparatus according to claim 2, wherein the tissue retaining element includes a connecting portion to which the biasing elements are respectively connected.
4. The apparatus according to claim 2, wherein the tissue retaining element has a basket-shape with four side walls and a bottom surface.
5. An apparatus for holding a tissue sample comprising, a retaining member having a first tissue engaging surface;

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- a base having a second tissue engaging surface; and at least one biasing element,
- wherein at least one of the first tissue engaging surface and the second tissue engaging surface is moveably attached to at least one of the retaining member and the base by said biasing element,
- wherein the base and the retaining member are configured to engage each other to form an interior area with the first and second tissue engaging surfaces facing each other, and
- wherein the at least one biasing element urges at least one of the first tissue engaging surface and the second tissue engaging surface to retain the tissue sample there between in the interior area,
- wherein the retaining member has at least two biasing elements,
- wherein the at least two biasing elements urge the first engaging surface of the retaining member toward the second engaging surface of the base and maintain the engaging surfaces in a substantially parallel configuration,
- wherein the biasing element comprises:
- a pair of angled members, each having a first end and a second end,
- wherein each angled members being connected at its first end to the retaining member,
- wherein the pair of angled members extend in opposite directions to form a crossed configuration, and
- wherein the pair of angled members are each connected at its second end to opposite ends of the retaining element by a flexing portion to allow the pair of angled members to flex under pressure.

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